CLAIMS

What is claimed is:

1. An electrochemical device component, comprising:

an active metal electrode having a first surface and a second surface; and

a protective membrane on the first surface of the electrode and having a smooth gap-free interface therewith, the membrane being ionically conductive and chemically compatible with the active metal on a side in contact with the active metal electrode, and substantially impervious, ionically conductive and chemically compatible with active metal corrosive environments on the other side;

wherein the ionic conductivity of the membrane is at least 10^{-7} S/cm.

2. The component of claim 1, wherein the protective membrane comprises a composite, the composite comprising,

a first material in contact with the electrode, the first material being ionically conductive and chemically compatible with the active metal; and

a second material in contact with the first material, the second material being substantially impervious, ionically conductive and chemically compatible with the first material and active metal corrosive environments;

wherein the ionic conductivity of the composite is at least 10^{-7} S/cm.

3. The component of claim 2, wherein the ratio of the first material to the second material in the composite is less than 1-1000.

4. The component of claim 1, further comprising a current collector on the second surface of the active metal electrode.

5. The component of claim 1, wherein the ionic conductivity of the membrane is at least 10^{-6} S/cm.

6. The component of claim 1, wherein the ionic conductivity of the membrane is at least 10^{-5} S/cm.

7. The component of claim 1, wherein the ionic conductivity of the membrane is at least 10^{-4} S/cm.

8. The component of claim 1, wherein the active metal of the electrode is lithium or a lithium alloy.

9. The component of claim 2, wherein the first material comprises a material selected from the group consisting of active metal nitrides, active metal phosphides, and active metal halides, and active metal phosphorus oxynitride glass.

10. The component of claim 2, wherein the first material comprises a material selected from the group consisting of Li_3N, Li_3P and LiI, LiBr, LiCl, LiF, and LiPON.

11. The component of claim 2, wherein the second material comprises a material selected from the group consisting of glassy or amorphous metal ion conductors, ceramic active metal ion conductors, and glass-ceramic active metal ion conductors.

12. The component of claim 2, wherein the second material comprises a material selected from the group consisting of LiPON, $Li_3PO_4.Li_2S.SiS_2$, $Li_2S.GeS_2.Ga_2S_3$, LISICON, NASICON, sodium beta-alumina and lithium beta-alumina.

13. The component of claim 2, wherein the first material comprises a complex of an active metal halide and a polymer.

14. The component of claim 2, wherein the second material is an ion conductive glass-ceramic having the following composition:

Composition	mol %
P_2O_5	26-55%
SiO_2	0-15%
$GeO_2 + TiO_2$	25-50%
in which GeO_2	0--50%
TiO_2	0--50%
ZrO_2	0-10%
M_2O_3	0 < 10%
Al_2O_3	0-15%
Ga_2O_3	0-15%

Li_2O	3-25%

and containing a predominant crystalline phase composed of $Li_{1+x}(M,Al,Ga)_x(Ge_{1-y}Ti_y)_{2-x}(PO_4)_3$ where $X \leq 0.8$ and $0 \leq Y \leq 1.0$, and where M is an element selected from the group consisting of Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm and Yb and/or and $Li_{1+x+y}Q_xTi_{2-x}Si_yP_{3-y}O_{12}$ where $0 < X \leq 0.4$ and $0 < Y \leq 0.6$, and where Q is Al or Ga.

15. The component of claim 2, wherein the second material is a flexible membrane comprising particles of an ion conductive glass-ceramic having the following composition:

Composition	mol %
P_2O_5	26-55%
SiO_2	0-15%
$GeO_2 + TiO_2$	25-50%
in which GeO_2	0--50%
TiO_2	0--50%
ZrO_2	0-10%
M_2O_3	0 < 10%
Al_2O_3	0-15%
Ga_2O_3	0-15%
Li_2O	3-25%

and containing a predominant crystalline phase composed of $Li_{1+x}(M,Al,Ga)_x(Ge_{1-y}Ti_y)_{2-x}(PO_4)_3$ where $X \leq 0.8$ and $0 \leq Y \leq 1.0$, and where M is an element selected from the group consisting of Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm and Yb and/or and $Li_{1+x+y}Q_xTi_{2-x}Si_yP_{3-y}O_{12}$ where $0 < X \leq 0.4$ and $0 < Y \leq 0.6$, and where Q is Al or Ga in a solid polymer electrolyte.

16. The component of claim 1, wherein the protective composite is a laminate of discrete layers of the first material and the second material.

17. The component of claim 1, wherein the protective composite comprises a gradual transition between the first material and the second material .

18. A protective composite battery separator, comprising:

an ionically conductive first material or precursor that is chemically compatible with an active metal and air; and

a second material in contact with the first material, the second material being substantially impervious, ionically conductive and chemically compatible with the first material and active metal corrosive environments;

wherein the ionic conductivity of the composite is at least 10^{-7} S/cm.

19. The separator of claim 1, wherein the protective composite is a laminate of discrete layers of the first material and the second material.

20. The separator of claim 1, wherein the protective composite comprises a gradual transition between the first material and the second material .

21. A method of fabricating an electrochemical device component, the method comprising:

providing a protective membrane, the membrane being ionically conductive and chemically compatible with an active metal on a first side, and substantially impervious, ionically conductive and chemically compatible with active metal corrosive environments on the other side, the membrane having wherein ionic conductivity of at least 10^{-7} S/cm;

applying an active metal material to the first side of the composite to form an active metal anode.

22. The method of claim 21, further comprising applying a current collector to the active metal anode.

23. An active metal battery cell, comprising:

an active metal negative electrode having a first surface and a second surface;

a protective membrane on the first surface of the electrode and having a smooth gap-free interface therewith, the membrane being ionically conductive and chemically compatible with the active metal on a side in contact with the active metal

electrode, and substantially impervious, ionically conductive and chemically compatible with active metal corrosive environments on the other side, the membrane having wherein ionic conductivity of at least 10^{-7} S/cm;

optionally, an electrolyte; and

a positive electrode.

24. The battery cell of claim 23, further comprising a current collector on the second surface of the active metal electrode.

25. The battery cell of claim 23, wherein the protective membrane comprises a composite, the composite comprising,

a first material in contact with the electrode, the first material being ionically conductive and chemically compatible with the active metal; and

a second material in contact with the first material, the second material being substantially impervious, ionically conductive and chemically compatible with the first material.

26. The battery cell of claim 23, wherein the membrane is the sole electrolyte.

27. The battery cell of claim 23, further comprising a solid polymeric electrolyte.

28. The battery cell of claim 23, further comprising a gel type electrolyte comprising one or more non-aqueous electrolytes gelled with a gelling agent.

29. The battery cell of claim 28, wherein the electrolyte is selected from the group consisting of methyl cellulose, polyacrylonitrile (PAN), polyvinylidene fluoride (PVDF), PEO, and monomers that can be gelled *in situ* with heat or radiation.

30. The battery cell of claim 23, wherein the cell comprises a liquid electrolyte.

31. The battery cell of claim 30, wherein the liquid electrolyte consists essentially of organic solvents having a lower viscosity than that of ethylene carbonate.

32. The battery cell of claim 31, wherein the liquid electrolyte comprises solvents selected from the group consisting of ethers, esters, and organic carbonates.

33. The battery cell of claim 32, wherein the liquid electrolyte comprises solvents selected from the group consisting of 1,2-dimethoxy ethane (DME), tetrahydrofuran (THF), 2-methyltetrahydrofuran, 1,3-dioxolane (DIOX), 4-methyldioxolane

(4-MeDIOX), dimethylcarbonate (DMC), ethylmethylcarbonate (EMC), diethylcarbonate (DEC), and mixtures thereof.

34. The battery cell of claim 33, wherein the liquid electrolyte further comprises solvents selected from the group consisting of methyl formate (MF) and methyl acetate (MA).

35. The battery cell of claim 23, wherein the cell comprises an ionic liquid electrolyte.

36. The battery cell of claim 35, wherein the ionic liquid is selectred from the group consisting of imidazolium and pyridinium derivatives and phosphonium and tetralkylammonium compounds comprising 1-Ethyl-3-methylimidazolium tosylate (EMIM-Ts), 1-Butyl-3-methylimidazolium octyl sulfate (BMIM-OctSO4), 1-Ethyl-3-methylimidazolium hexafluorophosphate, and 1-Hexyl-3-methylimidazolium tetrafluoroborate.

37. The battery cell of claim 23, wherein the anode is lithium metal and the cathode is one of lithiated intercalation compounds and unlithiated intercalation compounds.

38. The battery cell of claim 37, wherein the cathode is selected to provide a cell voltage of from about 2 to 5 Volts.

39. The battery cell of claim 37, wherein the cathode is selected from the group consisting of Li_xCoO_2, Li_xNiO_2, $Li_xMn_2O_4$, $LiFePO_4$, $AgxV_2O_5$, $CuxV_2O_5$, V_2O_5, V_6O_{13}, FeS_2, TiS_2, MnO_2, CuO, Ag_2CrO_4, MoO_3, CuS and FeS.

40. The battery cell of claim 23, wherein the anode is lithium metal and the cathode comprises active sulfur.

41. The battery cell of claim 40, wherein the cathode is selected from the group consisting of elemental sulfur and polysulfides.

42. The battery cell of claim 23, wherein the cell is a primary cell.

43. The battery cell of claim 23, wherein the cell is a secondary cell.